Environmental Sociology, 2016
http://dx.doi.org/10.1080/23251042.2016.1155690

Environmental norms and electricity supply: an analysis of normative change and household solar PV in Australia

Fiona Haines [a]* and Dylan McConnell[b]

[a]*School of Social and Political Sciences, University of Melbourne, Parkville, Australia;* [b]*Melbourne Energy Institute, University of Melbourne, Parkville, Australia*

(*Received 16 October 2014; accepted 16 February 2016*)

This paper analyses normative change in electricity supply in order to understand the challenges associated with the introduction of a non-negotiable environmental norm, a change necessary to ensure long-term environmental sustainability of the supply system. The analysis combines the work of Wolfgang Streeck together with that of ecological modernisation to trace the fate of an environmental norm as it emerges within a complex pre-existing institutional context comprising social norms around accessibility, affordability and reliability as well as the more recent emphasis on the benefits of competition. The analysis shows how 'strong' forms of ecological modernist policy change, policies in which environmental norms were explicit, were vulnerable to carbon intensive businesses arguing that they posed too significant a social risk. Yet, solar PV has been associated with 'weaker' forms of ecological modernist policy development where solar proponents have succeeded in demonstrating, despite significant opposition, how solar PV can be embedded within the competition norm thereby promoting both competition and environmental goals. This weaker form of ecological modernist change may have far reaching unintended consequences as solar PV on residential houses enhances the capacity of those households as 'prosumers' to ensure their interests are better supported. An environmental norm may be established here but social norms around rights to an essential service may also be placed at risk.

Keywords: Solar PV; electricity governance; neoliberalism; norms; prosumerism

I. Introduction

Electricity supply is fundamental to contemporary industrialised life intimately involved in a multitude of daily tasks, in homes, workplaces, schools and hospitals. Yet, once considered an unalloyed social benefit, the electricity supply system now sits at the forefront of an ecological imperative to reduce greenhouse gas (GHG) emissions since 44% of global emissions emanate from coal-fired generation (IEA 2014). The essential, yet currently polluting, nature of electricity supply makes progress towards a more ecologically sustainable future important to understand. From an environmental sociological perspective, the environmental impact of electricity supply cannot be separated from social or economic concerns (Murphy 1995). There is a need to embed an environmental norm within the system, as a non-negotiable premise underlying 'whose knowledge counts' (Lockie 2015, 2) that can facilitate the decarbonisation and ultimate sustainability of the electricity supply system.

This paper grapples with normative change in the electricity supply system. We explore the fate of an environmental norm and how such a norm competes with, replaces or embeds itself within pre-existing norms currently associated within the supply of electricity. As we outline below, electricity supply in industrialised settings contains a range of norms that predate environmental concerns most specifically around affordability, accessibility and reliability (what might be termed 'legacy norms'). Further, in many countries, electricity supply has been privatised and liberalised with the norm of competition explicitly introduced to drive efficiencies and lower costs (Sioshansi 2008). In this shift, economic interests arise in importance to shape how social and environmental norms interact.

1.1 Exploring normative change: institutions, norms and technology

To investigate the conditions under which an environmental norm emerges and exerts leverage in this crowded normative space, our conceptual framing of the electricity supply system is as a formal legal-political institution that is shaped through a critical interaction with technology. Electricity supply as an essential element of industrialised society is well captured as an institution, a 'building block' that comprises obligations and responsibilities framed around particular normative expectations, expectations that shape the appropriate and the possible (Streeck and Thelen 2005, 9). This form of analysis focuses attention on enduring elements of a society that can be studied as an integrated yet fluid whole, capable both of stability as well as change. It teases apart the

*Corresponding author. Email: fsh@unimelb.edu.au

relevant networks of actors, formal rules, informal norms or assumptions that comprise the institution and critically the interaction between them (Clemens and Cook 1999) that draw on and reshape norms. The analysis below follows most particularly the work of Wolfgang Streeck (Streeck 2011, Streeck and Thelen 2005), work that combines historical and rational choice institutionalisms in a manner particularly helpful for exploring norms and their impact on institutional practice on the ground. Their work draws insight from rational choice institutionalism and its emphasis on strategic choices made by individuals to maximise their material benefits. Yet, it is critically informed by historical institutionalism which argues that choices are made in contexts of uncertainty, bound by particular institutional arrangements that shape and are shaped by the choices of actors over time (see also Hay and Wincott 1998). In interrogating decisions in institutional contexts, Streeck (2011) and Streeck and Thelen (2005) direct attention to the relationship between 'rule makers', 'rule takers' and third parties, a conceptual distinction that allows an exploration of the way behaviours are legitimised in a particular context. Norms that underpin these relationships are then also seen as authoritative. Transformation is explored by analysing how these positions of rule maker, rule taker and third party change over time and what the normative implications of such changes are.

An understanding of what a norm *is* in the context of an institution is important. Streeck (2011) argues that norms exist at two levels. There are explicit norms as stated in policy aims or as enshrined in the regulatory regimes, policy documents, laws and regulations that attempt to capture and give effect to those norms within a given institutional setting. Here, norms can be determined by understanding what the law says. But norms also are present in the assumptions or that guide everyday institutional practice. An analysis of norms needs to focus both on norms explicitly written down and how those norms are transformed in practice, what the rules 'really mean'(Streeck 2011, 142). As we will see below, this is particularly important since the explicit norms that comprise the electricity supply are understood to be in tension with one another (MacGill and Healy 2013). How specific rules are acted upon, then, may contribute to understanding of how priorities are determined when there is a normative conflict.

In understanding this dynamic, it is important not to be rigid in the identification of roles associated with particular actors. Streeck and Thelen (2005) argue these are conceptual rather than rigid distinctions. A rule-maker who sets the agenda or the rules for engagement within a particular setting may find their role and capacity alter with time and changing circumstances, and their role may be reversed. Interpreted as values or key principles, norms can be used by a range of actors to further a particular agenda or set of interests (Short and Clarke 1992; Clarke and Short 1993; Douglas 1992; Reichman 1998). Different institutional actors will draw on politically salient norms in an attempt to influence regulatory reform and the development of policy to advance their interests. In this struggle, the interpretation of specific rules drawing on explicit and implicit norms that 'fill in the gaps' between rules and the actual behaviour they purport to govern. Critically for Streeck and Thelen (2005), the enforcement or legitimation of particular norms by third parties contributes to identifying which norms exert greatest leverage over a particular institution. In the case of electricity supply, these third parties can be associated with a regulator or judge accepting or rejecting a particular interpretation of a law or regulation or a broader public 'third party' acceptance of the adequacy of electricity supply and its associated governance arrangements.

Analysis of the electricity supply system also requires understanding this institution's interaction with technology. Indeed, drawing on Streeck, it is possible to understand technology at different times as a rule maker (that is determining how electricity can be supplied), as a rule taker (that is being reshaped because of demands made by policymakers or electricity companies) or as a third party in the sense of limiting the demands of rule makers that supply take place under particular governance arrangements. For example, for many years electricity supply as a whole was seen as a 'natural monopoly' necessarily under the purview of a single supplier simply by virtue of the nature of the technology (Joskow 2007). Under privatisation, the technology of electricity supply system was transformed into a 'rule taker' with new computer software technologies, and later 'smart meters' were developed to allow consumers first to switch electricity providers and second to provide consumers, regulators and businesses greater information regarding electricity use.

Yet, it is not technology alone that acts within a given institution. Engineers, policymakers and special interest groups collectively influence what is seen as technologically possible (Geels and Schot 2007). The limited purview of these actors may inhibit technological change, constraining renewable technologies, for example to their 'niche' environments within pre-existing institutional or socio-technical contexts (Geels and Schot 2007; Smith and Raven 2012). Smith and Raven (2012) argue that, to be successful, such technology must either be able to 'fit and conform' within an existing framework or, if it cannot thrive this way, it must 'stretch and transform' that institution. Translated into the language of norms and sustainability, the environmental norm that is given expression through a given technology may thrive because of its compatibility with existing electricity supply norms or, if it is incompatible, the institution must be transformed to accommodate such technology.

The analysis below explores a popular technology, solar PV on individual household rooves (hereafter solar PV), to explore its impact on generating an environmental norm in the electricity supply system (a) in policy and (b) in practice. To do so, we are interested in understanding the relationship between an environmental norm and pre-existing norms in the electricity system. We have chosen solar PV because of its capacity to radically reshape the

electricity supply institution by transforming householders as producers not simply consumers of electricity. The introduction of solar PV is clearly associated with an environmental norm, particularly when compared with fossil fuels and nuclear power (Shrader-Frechette 2013; Schwartzman 1996). However, complexity arises in how this technology and the environmental norm fares over time and in particular when the social, economic and technological actors involved in its promotion threaten incumbent actors and pre-existing norms.

Further, solar PV might be better understood as an ambiguous technology. This ambiguity stems from its capacity to inhabit norms that can be viewed sociologically as in tension with one another: environmental norms on the one hand and competition norms on the other (Dauvergne 2008; Wright and Nyberg 2015). Specifically, this renewable technology transforms citizens from consumers to prosumers (Comor 2011; Ritzer and Jurgenson 2010) able to both produce and consume electricity (Rathnayaka et al. 2012) and because of this places citizens in a stronger position to affect change in the electricity supply industry. Prosumers emerge as potential rule makers rather than simply rule takers. It is disruptive technology. Arguably, material (cost savings) *and* household environmental values can be served through solar PV use. Solar PV households can reflect either a market competition or an environmental norm or both. This ambiguity is of considerable sociological interest. It can contribute to debates on how neo-liberal markets grapple with ecological sustainability (Dauvergne 2008) as well as the destructive or, following an ecological modernist framework, the essentially liberating role technology can play in providing solutions to the current environmental crises (for helpful discussions see Paredis 2011; Gunderson 2015). The relationship between ecological modernisation and an environmental norm varies within this literature. On the one hand, in what has been termed 'weak ecological modernisation' the environmental norm is somewhat absent and subsumed under the problem solving capacity of technology. At the other end of the spectrum 'strong' forms of ecological modernisation equate more easily with an environmental sociological emphasis of the need to foreground an environmental norm (Christoff 1996, Gibbs 2006). The question arises whether the normative ambiguity of solar PV is more suited to a weak rather than a strong establishment of an environmental norm within the electricity supply industry.

The empirical focus of the paper is normative contest in Australia. Australia is important for several reasons. First, Australia has unprecedented levels of household solar PV, with 1.5 million households now connected, representing 16% of all households in the country, which now makes Australia the industrialised country to have the widest distribution of this technology (Clean Energy Regulator 2014). Second, Australia has the highest emissions per capita in the industrialised world (Meinshausen et al. 2015) and a significant proportion of this comes from electricity and the abundant supply of coal with 76% of electricity supplied from coal (Australian Energy Regulator 2014). A transition in this industry is clearly important. Third, there has been an unanticipated decline in electricity demand in Australia that challenges the profitability of incumbent commercial actors (Saddler 2013, Sandiford et al. 2015) and so a reaction against new entrants such as renewables, drawing on diverse norms to bolster particular arguments, is likely. Contests around which norms should take precedence are likely to increase at such times, and understanding the fate of an environmental norm in such a context is important as challenges to incumbent fossil fuel-based industries increase. Finally, Australia's electricity supply system is characterised by the strength of neo-liberal reforms aimed at subjecting a centralised networked essential service to competitive pressure and thereby increasing the efficiency of the system (Pfeifenberger, Spees, and Schumacher 2009). Its electricity system is often studied because of this neo-liberal experiment.

The analysis below draws together academic papers with key reports, policy documents, laws, regulations and legal cases on the electricity supply system in Australia with a predominant focus of 1990 to mid-2014. A regulatory mapping exercise was undertaken by the authors to trace relevant policies, laws and regulations to understand the formal norms associated with electricity supply. This is supplemented by an analysis of major changes to the electricity supply institution particularly, as it affected the competition norm. Material on the solar PV industry and technical market analyses of the merit order effect (MOE) by one of the authors (O'Connell et al. 2013) was also a critical element to the analysis. This same author has been intimately involved with renewable technology, and in particular solar PV, for the past six years. As such, he can be understood, to an extent at least and for the purposes of this analysis, as a participant observer.

2. Tracing norms in the Australian electricity supply system prior to solar PV

2.1 A brief history (pre 1990): development of norms of affordability, accessibility and reliability

In keeping with an historical institutionalist orientation, the first step in our analysis is to understand norms within the electricity supply industry that predated the introduction of solar PV. Australia in common with other industrialised nations sees electricity as an essential service. Australia is a federation, and prior to 1990, electricity supply was fundamentally seen as a state responsibility. Multiple sources of generation and forms of both public and private ownership within each state were consolidated over time into state-owned monopolies responsible for generation, distribution and supply (illustrated on the left-hand side of Figure 1). Significant actors comprised state governments, engineers, workers and their unions, citizens and businesses as users of electricity. Government was the dominant 'rule maker' in this setting. Early

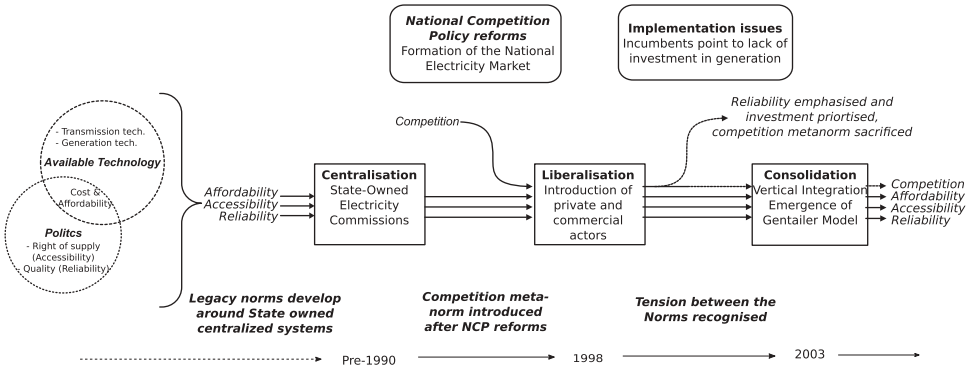

Figure 1. Development of norms around electricity provision.

debates among these actors focused cost to and access for citizens. 'Affordability' and 'accessibility' emerged as dominant norms that were realised through price equality for all citizens, irrespective of their location or the actual cost of bringing electricity to them. These norms and how they were realised in practice (state ownership and fixed prices for all) aimed to socialise the benefits of the electricity supply equally for all citizens. This was a significant demand given the size of Australian states and their dispersed populations. Nonetheless, common tariffs existed in each state. These demands for universal supply at equal cost developed generation and distribution technology that in turn shaped the industry. Centralised generation within each state required technology that could span over long distances essentially through A/C power lines, resulting in complex grid systems with different voltages (Patterson 2004). This encouraged the exploitation of cheap sources of power, such as brown coal in Victoria (Abbott 2006).

2.2 *Neo-liberal market reforms from 1990: the emergence of the competition norm*

Concerns with rising cost to government (i.e. to the 'public purse') rather than costs to users that began in New South Wales and spread across other states led the shift away from publicly owned and consolidated electricity supply monopolies and towards greater interconnection and inter-regional trade and ultimately a national electricity market (NEM). This advent of liberalisation and competition within the electricity industry clearly cannot be understood in isolation from the broad neo-liberal shifts that occurred in Australia and internationally through the 1980s and 1990s (Bell 1997; Lloyd 2002). In what Lloyd (2002) termed a 'regime change' across Australia, general competition came to be seen as the primary vehicle by which public welfare would be secured. Of particular relevance to the analysis here is the increase in the status and the influence of neo-classical economics (and economists) within the country both within and outside the government. This influence is evident in inquiries of the time, such as the newly created Industry Commission (later Productivity Commission) report entitled *Energy Generation and Distribution* in 1991 (Industry Commission 1991) and, most particularly, *National Competition Policy* chaired by Professor Fred Hilmer (Hilmer Committee 1993). Market logic dominated these reports. For example, the earlier concerns with fairness and affordability realised through a common tariff were now viewed as 'undesirable and inefficient cross subsidies'. These reports informed a 'Competition Principles Agreement' between state governments to facilitate the introduction of a market-based, competitive electricity supply system. The influence of neo-classical economists in the development of the NEM was evident. Steven King (2010, 223), a prominent Australian economist, wrote approvingly of this influence:

> In Australia, the National Electricity Market is a 'synthetic market'. It did not arise naturally, but was deliberately created by Australian governments using the tools of microeconomics. Every time you turn on a light switch, you are participating in a market designed and run by microeconomists.

Neo-classically trained economists acted as 'rule makers' in their own right through their influence on the rules governing the NEM. Public benefit was no longer secured by government provision but by harnessing competition. Legacy norms (around security, reliability and affordability) through utilising the benefits of competition bound by the limits of existing technology. Competition was seen as a meta-norm to drive efficient achievement of legacy norms (see Figure 1). This is evident in the highest point of reference for policy settings, the National Electricity Objective (NEO) which is referenced in the National Electricity Law (NEL) and enshrined in the *National Electricity Act 1996 (SA)*. The *National Electricity Act 1996 (SA)*, Part 1, Section 7 states that the NEO is 'to promote *efficient investment* in, and *efficient operation and use* of, electricity services for the long term interests of consumers'(italics added). This is to be achieved with respect to: first, 'price, quality, safety, reliability, and security of supply of electricity' and second the 'reliability, safety and security of the national electricity system'.

A belief in the disciplining power of competition to maximise efficiency drove structural changes within the

electricity supply system. Vertical disaggregation, corporatisation and privatisation introduced limited competition at each level of the industry except transmission and distribution systems which were seen as 'natural monopolies'. The original market design was that generators and retailers would compete within their own 'layer' of the market to increase efficiency and keep electricity prices down (Outhred 1998). Market competition would provide the necessary investment in new infrastructure (particularly in generation) based on the price signal visible through wholesale 'spot' market prices, with a price in each of the five regions that made up the NEM. These continue to sell electricity from generators to retailers based on a price calculated each half-hour.

Discipline through competition within the NEM did not arise because of a multiplicity of suppliers meeting the exacting demands of knowledgeable consumers. Rather, it is competition by regulatory proxy (Outhred 1998). Whether this market is deemed as competitive or not is framed in a complex fashion through the rules designed and enforced by a suite of regulators. The major bodies are the Australian Energy Market Commission (AEMC) charged with designing the rules in order to mimic competition, the Australian Energy Regulator (AER) enforces these rules, and the Australian Energy Market Operator (AEMO) operates the market. Mergers and Acquisitions, general competition regulation and consumer protection are monitored by the national competition regulator, the Australian Competition and Consumer Commission (ACCC). These regulations and regulators at the heart of the NEM combine in an attempt to preserve the legacy norms of affordability, accessibility and reliability along with the norms of competition and efficiency (see centre of Figure 1). The rules governing the NEM and their enforcement exert a strong influence on the particular character of both legacy norms and the competition meta-norm.

2a The (non) realisation of the competition norm

The meaning of competition has been radically reshaped over time through the influence of several new actors that gained importance through the creation of the NEM: economists (key actors in designing policy and working within the regulatory agencies), for-profit actors (generators, owners of distribution networks and retailers) and derivatives markets as well as the new regulatory bodies highlighted earlier. This reshaping saw a common interest develop between retailers and the newly privatised coal-fired generators. Together, these actors were able to exploit the rules designed to engender competition and redefine what competition meant in practice to suit their interests.

The redefinition of the competition norm was achieved in two ways. The first of these was through a significant increase in control of the electricity market by key firms. They were able to do this by drawing on the norms of reliability. Rising demand in the mid-2000s saw these companies (and their lawyers) able to convince courts and some high-profile economists (Simshauser 2010) that there was not enough incentive for them to build new coal-fired sources of generation. Together, private generators and economic commentators exerted leverage over the federal and state governments' anxieties around reliability of supply to undermine the competition norm in practice. Private generators pursued a strategy of cross-ownership with retailers, an arrangement which would allow higher and more secure profits for both parties. Whilst this was not explicitly forbidden by the rules, it was a serious concern to the competition regulator the ACCC. However, the ACCC was unable to enforce a ban on cross-ownership. It failed to prevent AGL, a retailer, buying a major stake (35%) in a key Victorian generator in the significant case *Australian Gas Light Company (AGL) vs. ACCC (No 3)* in the Federal Court of Australia in 2003 (Federal Court of Australia 2003). By 2012, the competition regulator decided not to take action against a full takeover by AGL of the same power station (ACCC 2012). As a result of these and other decisions, the number and size of 'gentailers,' that is retailers and generators belonging to the same company, grew.

The second way redefinition was achieved involved these same actors bypassing the wholesale market set up by the NEM. Wholesale markets and the visible price on such markets provide the essential 'price signal' that should discipline private companies to be efficient providers of, in this case, electricity. This wholesale market allows generators and retailers to trade electricity on a price determined every 30 minutes. This price is extremely volatile (ranging from around a price floor of – (minus) $1000 per MWh to the price cap of $12,900 per MWh in the financial year 2012–2013). Cross-ownership and hedging provide varying degrees of respite from this market. Gentailers bypass the spot market entirely and, in the short and medium term at least, no longer need to be disciplined by this visible and volatile price. Indeed, they can profit from it by selling their own generation when prices are high and buying power in when prices are low. Bi-lateral contracts between other generators and retailers outside of this visible market also provide respite. In the case of both gentailers and forward contracting the price of electricity is not only more stable but on average higher than the spot market price (Anderson, Hu, and Winchester 2007). New entrant generators, which happen to be mostly renewable energy generators, are more dependent on this visible wholesale or spot prices.

Overall, within the NEM, competition has proved an elusive and somewhat fickle norm. Leverage by incumbent actors weakened the competition norm, reshaping what competition 'really meant' in practice through appeals to the reliability norm, a norm most consistent with the material interests of the private electricity market actors. This redefinition has allowed the emergence of cross-ownership (gentailers) and greater market concentration which, together with hedging practices, has undermined the price signal by obscuring the actual price of wholesale electricity. If we return to Streeck and Thelen's argument that norms should be enforced to be understood

as key to an institution's character, competition could neither be seen as a strong nor a stable norm of the electricity supply system. Australia has not been alone here. In the United States, Borenstein and Bushnell (2015, 438) also have argued that

> . . .although the restructuring era dawned with great hope that regulatory innovations, and the incentives provided by competition, would dramatically improve efficiency and greatly lower consumer costs, that hope was largely illusory.

2.3 *Solar PV and the promise of 'green competition'*

New actors promoting renewable energy have entered the electricity market despite the lack of incentive provided by the NEM itself. This has arisen because of specific incentives given to renewable energy (see the left-hand side of Figure 2) with Solar PV being one of the main beneficiaries. This incentive is associated with the Renewable Energy Target (RET), an environmental target introduced in 2001 to ensure that 41,000 Gwh of Australia's electricity (presumed to be around 20%) would be supplied by renewable sources by 2020. This policy introduced a trade in Renewable Energy Certificates that was complemented by state-based Feed in Tarrifs (FiTs). This resulted in a significant uptake of solar PV creating a subsidised 'niche' ecosystem. This ecosystem has its own regulator, the Clean Energy Regulator (CER) that intersects with, but is largely separated from, the NEM. In essence, the CER as 'third party' enforces the environmental norm in the electricity supply system as set down in the relevant legislation.

The absence of an explicit environmental norm is written into law and regulation within the NEM-pushed proponents of solar PV, specifically technological (and largely pro-environmental) experts and the solar PV industry, to argue its viability within the existing NEM framework and norms. Their arguments attempted to embed the environmental norm *within* the competition norm, specifically arguing that the technology was good not only for those with solar PV but also that it reduced prices for all consumers. Their argument around the competitive potential of solar PV in Australia is centred on solar PV's capacity to exploit the inner workings of the 'synthetic market' making electricity cheaper for all consumers in the NEM.

The promise of solar PV being able to provide 'green' competition that can achieve both economic and environmental gains is bound up with the policy orientation and regulatory arrangements that frame the NEM. Two elements, 'grid parity' and the 'MOE', shape this policy background. Both are artefacts of the NEM. Grid parity is understood as the point at which it is 'economically rational', as the cost of the technology declines, to build rooftop solar to offset the cost of grid electricity to the consumer under current electricity market arrangements. In ongoing vigorous debates around 'grid parity' proponents of solar PV argue that this point has now been reached in some jurisdictions (Lund 2011; Bazilian et al. 2012; Breyer et al. n.d.), including Australia (Watt, Passey, and Johnston 2012).

A closer analysis of the MOE is particularly helpful in exploring how solar PV proponents use the competition norm as leverage for the technology's viability. They argue that the MOE reduces the price of electricity *for all consumers* not just those with PV on their rooves. Many electricity markets, including Australia, the United States, United Kingdom and New Zealand, use a variation of the 'economic dispatch' or 'merit order dispatch' system. This

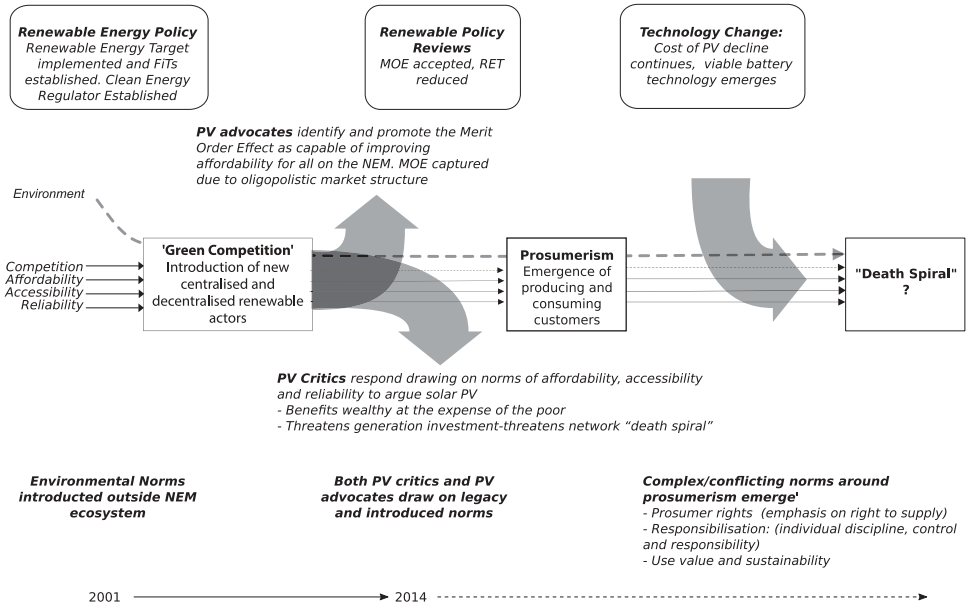

Figure 2. Development of norms around electricity provision following the introduction of solar PV.

system uses algorithms to optimise the dispatch of electricity, ensuring reliability whilst minimizing the total cost of generation. Conceptually, generation is dispatched in 'order of merit' (i.e. from lowest cost to highest cost). Renewable generation typically has low marginal costs and is thus employed first in the merit order of power generation. This has the dual impact of displacing other generation and lowering the wholesale electricity pool price. While bidding strategies are more complicated than simply using short-run marginal costs of production, they are strongly informed by them. Clearly, any technology that has zero input costs, including solar PV, can generate a MOE in markets that are constructed to prioritise low marginal cost generation.

A market logic based on a competition norm suggests that a lower spot price should reduce costs to consumers. Studies from across jurisdictions emerged arguing essentially that environmental norms could be embedded within the competition norm. Studies (e.g. Rathmann 2007) were undertaken to illustrate how this may take place and under what conditions. Analyses in Denmark (Munksgaard & Morthorst 2008), Germany (Sensfuß, Ragwitz, and Genoese 2008) and Spain (Sáenz de Miera, del Río González, and Vizcaíno 2008) each showed a reduction in wholesale prices due to a MOE resulting from renewable generation. These studies even argued that this reduction could exceed the value of support payments made to renewable generators resulting in a net overall benefit to consumers and government from renewable energy. In Australia, too, work estimated that solar PV could generate significant reductions ($1.8bn) in the spot market price (McConnell et al. 2013).

But there is a significant qualification needed at this point. The MOE is to a considerable extent 'manufactured' by the rules of the NEM which govern how the spot market works and decisions of regulators as third-party enforcers which 'fill in the gaps' of what competition means in practice. For 'green competition' to work electricity actors would either need to behave according to standard economic assumptions regarding competitive markets namely to pass on lower wholesale prices to consumers. If they failed to do so regulators would enforce these rules to act to ensure they did. Only under this scenario could this synthetic market be able to keep prices low and deliver green outcomes. The analysis in Section 2.2a suggests considerable challenges achieving this because of the capacity of electricity market actors, generators and retailers, to act instead as rule makers in the sense of reshaping what competition meant in practice.

When a challenge to their profitability arose from renewables, including solar PV, the incumbent industry used their influence again as 'rule makers' drawing on norms of security, accessibility and affordability to constrain this new source of competitive pressure. The declining demand for electricity in Australia intensified the concerns of these generation businesses (AEMO 2012). To escape competitive pressure, incumbents and industry experts drew on the very norm, competition, that which was undermined when cross-ownership was allowed to flourish. In a somewhat hypocritical argument, FiTs as well as the RET were accused of 'distorting' competition (Donoghue 2012; Nelson, Simshauser, and Nelson 2012; Felder 2011). They argued the 'oversupply' of electricity should be remedied by changing the RET and reducing subsidies but *not* removing cross-ownership between retailers and generators and allow inefficient incumbent generators to fail.

Incumbents were particularly successful in pushing for a reduction in the RET, the main repository for an environmental norm. A review entitled *The Renewable Energy Scheme: Review of the Expert Panel* (hereafter Expert Panel) argued for either a freezing of the RET to new entrants or what was a termed a 'true' 20% RET consistent with the decline in demand. This was despite the actual target as stated in legislation as 41,000Gwh of supply, a figure providing certainty to the emerging renewables industry. The Expert Panel (2014) based its analysis on a continued need for carbon-intensive generation. Existing technology shaped its view of *which* actors needed a secure investment environment and which did not (cf. Geels and Schot 2007). In the following quote, the two means by which renewables could be expected to benefit (and a sustainable environmental norm established) were criticised: the RET and the spot price. The Expert Panel (2014, i) recognised the impact of renewables on the wholesale price (due to the MOE and structure of the NEM), but prioritised the need for security in investment decisions in fossil-fuel-based generation and centralised distribution:

> Analyses suggest that, overall, the RET is exerting some downward pressure on wholesale electricity prices. This is not surprising given that the RET is increasing the supply of electricity when electricity demand has been falling. *Artificially low wholesale electricity prices can distort investment decisions* in the electricity market and are unlikely to be sustained in the long term. Over time, all other things being equal, wholesale electricity prices could be expected to rise to *better reflect the cost of generating electricity.* (italics added)

This analysis very clearly placed the environmental norm enshrined within the mandate of Clean Energy Regulator (CER), as well as the spot price, as subservient to the legacy norms within the NEM. Despite a vigorous campaign, policy change following the review saw a reduction of the RET to 33,000Gwh.

In short, the capacity of renewable proponents to argue the competitive potential of solar PV, that is to embed the environmental norm within the competition norm, has faced a number of challenges. The competition norm itself, as outlined in Section 2.2, is neither strong nor stable, so attempts to utilise this norm to further solar PV may be expected to struggle. Cross-ownership (increasing market concentration) and hedging practices (obscuring the wholesale price) limited the capacity of solar PV to

lower the wholesale price and generate a MOE. Nonetheless, the effect it did exert was targeted by policies that moved further away from a strong competition norm (e.g. by unwinding cross-ownership arrangements and allowing some generators to fail). The environmental norm in a separate legislative framework, overseen by the Clean Energy Regulator, designed specifically to promote renewable energy, was scaled back.

2.4 The rise and impact of the prosumer?

The outcome of the Expert Panel and its antipathy to renewables failed to curb the support for household solar PV. Solar PV was explicitly exempted from any adverse policy effects. This supports an understanding of Solar PV householders as electricity prosumers, shifting their market position to a blend of production and consumption and hence able to exert additional influence on the electricity supply system.

Analysis of what prosumer behaviour may look like and what it suggests for an environmental norm, then, is timely. Control of prosumers may not be as straightforward as the control of consumers since prosumers enjoy their increased independence and resist coming back under corporate control or paying for services they now enjoy for free (Ritzer and Jurgenson 2010) . Prosumers may premise their behaviour on social and not just economic values (Ritzer and Jurgenson 2010). Prosumerism has been linked to two different value orientations: specifically exchange-value and use-value (Comor 2011). In terms of the electricity supply system, exchange value centres on the sale and purchase of electricity as a commodity, whilst a use-value emphasis within prosumerism would centre on an ethic of self-sufficiency (see right-hand side of Figure 2).

At the present time, prosumerism associated with solar PV is a complex blend of use and exchange values. For example, the main impact of solar PV on the current electricity market may be more in terms of reducing the need to purchase electricity (use-value for individual householders) rather than as a form of micro-generation (self-sufficiency as exchange-value). This reduction in demand is one of the contributors to the overall decline in demand for electricity in Australia (Sandiford et al. 2015). The carbon-intensive nature of the electricity supply in Australia means a reduction in demand is, to an extent at least, consistent with the development of an environmental norm within the NEM. A reduction in demand also produces a MOE by reducing peak demand (on hot sunny days when the spot price is high). This reduction in demand also reduces the need for householders to draw from the grid so that the need for costly upgrades to provide additional network capacity may be reduced (AEMO 2013). Environmental norms are achieved by enhancing the efficiencies a competition norm is intended to bring.

Use-value associated with prosumerism also presents complex normative implications that need to be considered alongside the development of an environmental norm. For some prosumerism reduces alienation and reawakens authenticity (Comor 2011) aligned with self-sufficiency and environmentalism (Palm and Tengvard 2011). Yet, self-sufficiency is also consistent with individualism and a lack of a collective ethic around the right to an essential service as people become 'responsibilised' citizens (O'Malley 1992). Here, the state is provided an opportunity for the state to reduce its own responsibilities in this case for the supply of electricity. A greater emphasis on the responsibilised individual prosumer encourages and disciplines them to monitor their own behaviour around *how much* electricity to use and critically *when*. Citizens may yet bear a greater and greater share of the risk for the provision and maintenance of electricity supply. This, in turn, requires increased knowledge and time, which are unequally available, as well as considerable emotional investment (see for example Jamasb and Pollitt 2008).

The combination of increased state emphasis on individual responsibility for electricity supply and the 'pull' demands of those prosumers based on economic benefit and self-sufficiency may stimulate greater levels of household PV that could 'stretch and transform' electricity supply in a form of disruptive decentralisation (see Figure 2). In this context, technological innovations provide a series of further options. There is an increased possibility for some to utilise battery storage to lessen their dependence on the grid. Recent estimates are that 50% of generation, assisted by battery storage, may take place outside of the electricity grid by 2030 (Parkinson 2015). However, problems emerge when total electricity self-sufficiency becomes a popular alternative. Indeed, some authors point to the problem of the evocatively named 'death spiral' where those remaining are required to pay higher and higher network charges encouraging further defection from the system as householders increasingly remove themselves from the network (Priest 2012). Solutions which involve increased charges (either by government or by incumbents) for those with solar PV may simply exacerbate demand for removal from the grid entirely. This may provide the trigger for government itself to begin to question its support for a comprehensive networked system. Environmental gains may come at the expense of increased social marginalisation for the most vulnerable.

3. Conclusions

The analysis of the electricity supply system as an institution has shown the way the institution was initially framed around a collective ethic of accessibility, reliability and affordability for all realised through government ownership and control. The competition norm introduced in the 1990s that was institutionalised in law and regulation was initially designed as a meta-norm to enhance these legacy norms whilst reducing the burden on government. The letter of the legislative reforms to introduce competition was drafted by governments as 'rule makers'. Yet a

reinterpretation of what competition meant in practice emerged as the newly privatised industry gained traction as rule makers in their own right. This reinterpretation saw a definition of competition develop that was compatible with, and subservient to, the need for ongoing investment in emissions intensive generation. This emphasis on the need to protect investment in emissions intensive generation was evident both before the wide dissemination of solar PV (in the decisions made to allow gentailers) and after widespread solar PV usage (in the decision to reduce the RET). Despite this emphasis renewable technologies have developed in Australia. Solar PV in particular has flourished. The reasons for this are explained not only by the RET and state-based subsidies but also because of the compatibility of solar PV with the competition meta-norm. Proponents of renewable energy bought this compatibility to light by tying competition not to reliability but to the legacy norms of affordability through their analysis of the MOE. Solar PV, they argued, could reduce prices for all. Where the RET and FiT are under the control of governments as rule makers, the emergence of solar PV households as prosumers has seen households capable of redesigning the electricity supply to suit their own needs. Prosumers are now emerging as 'rule makers'.

What then are the implications for the establishment of an environmental norm within the electricity supply system? With federal and state governments in the position of rule maker, the environmental norm has been enshrined in laws and regulations outside of the NEM in the form of the RET and feed in tariffs. These might be viewed as compatible with strong forms of ecological modernisation since they are explicit in their environmental intent. Yet, 'weaker' ecological modernist developments, where environmental norms are embedded within a competition norm, have been equally important in the Australian context. Both the 'strong' and 'weak' forms of ecological modernisation have been vulnerable to ongoing demands for the protection of emissions intensive generation. In the case of the former, legislative and regulatory regimes associated with the RET and FiT have been changed to weaken the incentives for renewable energy. In the case of the latter, there has been recent public recognition of the impact of the MOE but this has been used as evidence for the need for further scaling back of renewable generation.

Solar PV, though, has the capacity to engender normative change because the technology changes the rule maker/rule taker dynamic. Understanding the PV-owner as a prosumer provides insight into possible futures which may yet 'stretch and transform' the electricity supply system in the form of disruptive decentralisation. However, the implications for an environmental norm are less clear. On the one hand, Solar PV may promote neoliberal sensibilities in 'prosumers' who may then push to have their (economic) interests better met. An environmental norm may yet be embedded within a newly emergent competition norm. On the other hand, it may engender more of a use-value ethic of generating and using electrical power. This future is certainly attractive to those who argue the compatibility of self-sufficiency and environmentalism. However, our analysis also shows that self-sufficiency is also consistent with the disciplining of the citizen as responsible for their own (electricity supply) future. New technology (specifically here battery technology) may either succour prosumers angry at government's rejection of their (material, environmental and/or political) interests or provide solutions for a government seeking to wean the citizenry off their demand for electricity security.

The lessons for environmental sociology in understanding the transformation of electricity supply are equally complex. Strong forms of ecological modernisation where an environmental norm is given priority in shaping which technology is supported, and which allowed to decline, require close attention to political economy. In particular, the analysis above suggests environmental norms do not have an automatic compatibility with socially progressive norms (e.g. around universal accessibility to an essential service). The potential conflict here provides a rich terrain for carbon intensive businesses to utilise social norms to press their material advantage and undermine a strong ecological modernist trajectory by arguing the social benefits of their continued presence. However, solar PV and prosumerism does breathe new life into the potential for compatibility between environmental and competition norms. This technology might be viewed as a prominent illustration of logic of 'weak' forms of ecological modernisation where an environmental norm is embedded within pre-existing norms. Yet, our analysis suggests that solar prosumerism is itself premised on a complex tension between neo-liberal values of individualism, rights and a weakening of ties to the state and its responsibilities for universal provision of service on the one hand and self-sufficiency and environmentalism on the other. The introduction of the prosumer as rule-maker increases the probability of a decline in the centralised electricity system – and the socialised benefits that lay behind its creation. Environmental and competition norms may be more closely aligned, but at the expense of the social.

Acknowledgements

The authors would like to thank Anne Kallies for her helpful comments. The authors also thank Peter Christoff and Roger Dargaville for their comments on early drafts.

Funding

The research in this paper was supported by the University of Melbourne's Interdisciplinary seed grant.

Disclosure statement

No potential conflict of interest was reported by the authors.

ORCID

Fiona Haines http://orcid.org/0000-0001-6845-3522

Notes on contributor

Fiona Haines is Professor of Criminology at the School of Social and Political Sciences, University of Melbourne.

Dylan McConnell is a research fellow at the Melbourne Energy Institute at the University of Melbourne.

References

Abbott, M. 2006. "The Performance of an Electricity Utility: The Case of the State Electricity Commission of Victoria, 1925-93." *Australian Economic History Review* 46 (1): 23–44. doi:10.1111/j.1467-8446.2006.00150.x.

ACCC. 2012. ACCC not to oppose AGL's acquisition of Loy Yang Power. Accessed 15 October 2014. http://www.accc.gov.au/media-release/accc-not-to-oppose-agls-acquisition-of-loy-yang-power

AEMO. 2012. National Electricity Forecasting Report. Melbourne. Accessed 15 October 2014. http://www.aemo.com.au/Electricity/Planning/Forecasting/National-Electricity-Forecasting-Report-2012

AEMO. 2013. The National Electricity Forecasting Report 2013. Melbourne. Accessed 15 October 2014). http://www.aemo.com.au/Electricity/Planning/Forecasting/National-Electricity-Forecasting-Report-2013

Anderson, E. J., X. Hu, and D. Winchester. 2007. "Forward Contracts in Electricity Markets: The Australian Experience." *Energy Policy* 35 (5): 3089–3103. doi:10.1016/j.enpol.2006.11.010.

Australian Energy Regulator. 2014. "National Electricity Market consumption". Accessed 5 September 2014. https://www.aer.gov.au/node/9765.

Bazilian, M., I. Onyeji, M. Liebreich, I. MacGill, J. Chase, J. Shah, D. Gielen, D. Arent, D. Landfear, and S. Zhengrong. 2012. Re-considering the Economics of Photovoltaic Power. Bloombery New Energy Finance. Accessed 9 November 2015. http://bnef.com/PressReleases/view/216

Bell, S. 1997. *Ungoverning the Economy: The Political Economy of Australian Economic Policy*. Melbourne: Oxford University Press.

Borenstein, S., and J. Bushnell. 2015. "The US Electricity Industry After 20 Years of Restructuring." *Annual Review of Economics* 7 (1): 437–463. doi:10.1146/annurev-economics-080614-115630.

Breyer, C. A., G. J. Meuller, H. Behacker, and A. Milner. 2009. "Grid Parity Analysis for EU and US regions and Market Segments - Dynamics of Grid-Parity and Dependence on Solar Irradiance, Local Electricity Prices and PV Progress Ratio." In *24th European Photovoltaic Solar Energy Conference*, 21–25 September 2009, Hamburg, Germany. Accessed 9 November 2015. http://www.eupvsec-proceedings.com/proceedings?paper=4898

Clarke, L., and J. F. Short Jr. 1993. "Social Organization and Risk: Some Current Controversies." *Annual Review of Sociology* 19: 375–399. doi:10.1146/annurev.so.19.080193.002111.

Clean Energy Regulator. 2014. "Small Scale Installations by Year". Accessed 15 September 2014. http://ret.cleanenergyregulator.gov.au/REC-Registry/Data-reports#Smallscale-installations-by-installation-year

Clemens, E. S., and J. M. Cook. 1999. "Politics and Institutionalism: Explaining Durability and Change." *Annual Review of Sociology* 25 (1): 441–466. doi:10.1146/annurev.soc.25.1.441.

Comor, E. 2011. "Contextualizing and Critiquing the Fantastic Prosumer: Power, Alienation and Hegemony." *Critical Sociology* 37 (3): 309–327. doi:10.1177/0896920510378767.

Dauvergne, P. 2008. *The Shadows of Consumption: Consequences for the Global Environment*. Cambridge, MA: MIT Press.

Donoghue, K. 2012. Submission to the Victorian Competition and Efficiency Commission's inquiry into feed-in tariff arrangements and barriers to distributed generation. Energy Supply Association of Australia.

Douglas, M. 1992. *Risk and Blame: Essays in Cultural Theory*. London: Routledge.

Expert Panel. 2014. *Renewable Energy Target Scheme: Report of the Expert Panel*. edited by, D. Warburton (Chair). Commonwealth of Australia. Accessed September 5 2014. https://retreview.dpmc.gov.au/sites/default/files/files/RET_Review_Report.pdf

Federal Court of Australia. 2003. *Australian Gas Light Company vs ACCC*. 1525. 19 December.

Felder, F. A. 2011. "Examining Electricity Price Suppression Due to Renewable Resources and Other Grid Investments." *The Electricity Journal* 24 (4): 34–46. doi:10.1016/j.tej.2011.04.001.

Geels, F. W., and J. Schot. 2007. "Typology of Sociotechnical Transition Pathways." *Research Policy* 36 (3): 399–417. doi:10.1016/j.respol.2007.01.003.

Gunderson, R. 2015. "Environmental Sociology and the Frankfurt School 2: Ideology, Techno-Science, Reconciliation." *Environmental Sociology* 1–13. doi:10.1080/23251042.2015.1052217.

Hilmer Committee. 1993. *National Competition Policy*. edited by F. G. Hilmer, M. R. Raynor, and G. Q. Tapperell. Canberra: Australian Government Printing Service.

IEA. 2014. CO_2 emissions from fuel combustion-highlights (2014 Edition). Paris, France: International Energy Agency. Accessed 9 November 2015. https://www.iea.org/publications/freepublications/publication/CO2EmissionsFromFuelCombustionHighlights2014.pdf

Industry Commission. 1991. "Energy Generation and Transmission." In *Inquiry Report of the Industry Commission*. Canberra Accessed 5 September 2014. http://www.pc.gov.au/industry-commission/inquiry/11energy

Jamasb, T., and M. Pollitt. 2008. "Security of Supply and Regulation of Energy Networks." *Energy Policy* 36 (12): 4584–4589. doi:10.1016/j.enpol.2008.09.007.

Joskow, P. L. 2007. "Chapter 16 Regulation of Natural Monopoly." In *Handbook of Law and Economics*, edited by A. M. P. Shavell and S, 1227–1348. Oxford: Elsevier.

King, S. P. 2010. "Using Microeconomics to Protect Competition." *Australian Economic Review* 43 (2): 217–224. doi:10.1111/j.1467-8462.2010.00588.x.

Latour, B. 1993. *We Have Never Been Modern*. Cambridge, MA: Harvard University Press.

Lloyd, C. 2002. "Regime Change in Australian Capitalism: Towards an Historical Political Economy of Regulation." *Australian Economic History Review* 42 (3): 238–266. doi:10.1111/aehr.2002.42.issue-3.

Lockie, S. 2015. "Why Environmental Sociology?" *Environmental Sociology* 1 (1): 1–3. doi:10.1080/23251042.2015.1022983.

Lund, P. D. 2011. "Boosting New Renewable Technologies Towards Grid Parity - Economic and Policy Aspects." *Renewable Energy* 36 (11): 2776–2784. doi:10.1016/j.renene.2011.04.025.

MacGill, I., and S. Healy. 2013. "Is Electricity Industry Restructuring the Right Answer to the Wrong Question? Lessons from Australian Restructuring and Climate Policy'." In *Evolution of Global Electricity Markets: New Paradigms, New Challenges, New Approaches*, edited by F. Sioshansi, 615–643. Amsterdam: Elsevier.

McConnell, D., P. Hearps, D. Eales, M. Sandiford, R. Dunn, M. Wright, and L. Bateman. 2013. "Retrospective Modeling of the Merit-Order Effect on Wholesale Electricity Prices from Distributed Photovoltaic Generation in the Australian National Electricity Market." *Energy Policy* 58: 17–27. doi:10.1016/j.enpol.2013.01.052.

Meinshausen, M., L. Jeffery, J. Guetschow, Y. Robiou du Pont, J. Rogelj, M. Schaeffer, N. Hohne, M. den Elzen, S. Oberthur, and N. Meinshausen. 2015. "National Post-2020 Greenhouse Gas Targets and Diversity-Aware Leadership." *Nature Climate Change* Advance online publication. doi:10.1038/nclimate2826.

Munksgaard, J., and P. Erik Morthorst. 2008. "Wind power in the Danish liberalised power market—Policy measures, price impact and investor incentives." *Energy Policy* 36 (10): 3940–3947. doi:10.1016/j.enpol.2008.07.024.

Nelson, T., P. Simshauser, and J. Nelson. 2012. "Queensland Solar Feed-In Tariffs and the Merit-Order Effect: Economic Benefit, or Regressive Taxation and Wealth Transfers?" *AGL Applied Economic and Policy Research* 22–22. http://www.aglblog.com.au/wp-content/uploads/2012/03/No-30-QLD-FiT-II-FINAL1.pdf

O'Malley, P. 1992. "Risk, Power and Crime Prevention." *Economy and Society* 21 (3): 252–275. doi:10.1080/03085149200000013.

Outhred, H. 1998. "A Review of Electricity Industry Restructuring in Australia." *Electric Power Systems Research* 44 (1): 15–25. doi:10.1016/S0378-7796(97)01210-8.

Palm, J., and M. Tengvard 2011. "Motives for and Barriers to Household Adoption of Small-Scale Production of Electricity: Examples from Sweden." *Sustainability: Science, Policy, Practice* 7 (1): 6–15. Published online May 26, 2011. Accessed 9 November 2015. http://www.google.com.au/archives/vol7iss1/1001-006.palm.html

Paredis, E. 2011. "Sustainability Transitions and the Nature of Technology." *Foundations of Science* 16 (2–3): 195–225. doi:10.1007/s10699-010-9197-4.

Parkinson, G. 2015. "Rooftop Solar, Battery Storage to Dominate Australian Grid." *RenewEconomy*, June 23rd. Accessed 29 September 2015. http://reneweconomy.com.au/2015/rooftop-solar-battery-storage-to-dominate-australian-grid-58078

Patterson, W. 2004. "Keeping the Lights On." *Working Paper No. 3*. Chatham House, London: Royal Institute of International Affairs. Accessed 9 November 2015. https://www.chathamhouse.org/sites/files/chathamhouse/public/Research/Energy,%20Environment%20and%20Development/wpjun04.pdf

Pfeifenberger, J., K. Spees, and A. Schumacher. 2009. "A Comparison of PJM's RPM with Alternative Energy and Capacity Market Designs." Prepared for PJM Interconnection, Inc. September.

Priest, M. 2012. "Power Marketin Danger of 'Death Spiral'." *Financial Review*, July 6, 2012. Accessed 13 November 2013. http://www.afr.com/p/national/power_market_in_danger_of_death_Js4vMlZHvEWHI5m2ISwXTP

Productivity Commission. 2012. "Electricity Network Regulation - Issues Paper. Productivity Commission." Accessed 13 November 2013. http://www.pc.gov.au/__data/assets/pdf_file/0017/115541/electricity-issues-paper.pdf

Rathmann, M. 2007. "Do Support Systems for RES-E Reduce EU-ETS-Driven Electricity Prices?" *Energy Policy* 35 (1): 342–349. doi:10.1016/j.enpol.2005.11.029.

Rathnayaka, A. J., V. M. Potdar, T. Dillon, O. Hussain, and S. Kuruppu. 2012. "Analysis of energy behaviour profiles of prosumers." Accessed 3 August 2013. http://ieeexplore.ieee.org/xpls/abs_all.jsp?arnumber=6301138

Reichman, N. 1998. "Moving Backstage: Uncovering the Role of Compliance Practices in Shaping Regulatory Policies." In *A Reader on Regulation*, edited by R. Baldwin, C. Scott, and C. Hood, 325–346. Oxford: Oxford University Press.

Ritzer, G., and N. Jurgenson. 2010. "Production, Consumption, Prosumption: The Nature of Capitalism in the Age of the Digital 'Prosumer'." *Journal of Consumer Culture* 10 (1): 13–36. doi:10.1177/1469540509354673.

Sáenz de Miera, G., P. del Río González, and I. Vizcaíno. 2008. "Analysing the Impact of Renewable Electricity Support Schemes on Power Prices: The Case of Wind Electricity in Spain." *Energy Policy* 36 (9): 3345–3359. doi:10.1016/j.enpol.2008.04.022.

Sandiford, M., T. Forcey, A. Pears, and M. Dylan. 2015. "Five Years of Declining Annual Consumption of Grid-Supplied Electricity in Eastern Australia: Causes and Consequences." *The Electricity Journal* 28 (7): 96–117. doi:10.1016/j.tej.2015.07.007.

Schwartzman, D. 1996. "Solar Communism." *Science & Society* 60 (3): 307–331. doi:10.2307/40403574.

Scott, W. R. 2001. *Institutions and Organizations*. London: Sage.

Sensfuß, F., M. Ragwitz, and M. Genoese. 2008. "The Merit-Order Effect: A Detailed Analysis of the Price Effect of Renewable Electricity Generation on Spot Market Prices in Germany." *Energy Policy* 36 (8): 3086–3094. doi:10.1016/j.enpol.2008.03.035.

Short Jr., J. F., and L. Clarke. 1992. "Social Organization and Risk." In *Organizations, Uncertainties and Risk*, edited by J. F. Short Jr and L. Clarke, 309–321. Boulder, CO: Westview.

Shrader-Frechette, K. 2013. "Answering "Scientific" Attacks on Ethical Imperatives: Wind and Solar Versus Nuclear Solutions to Climate Change." *Ethics and the Environment* 18 (1): 1–17. doi:10.2979/ethicsenviro.18.1.1.

Simshauser, P. 2010. "Vertical Integration, Credit Ratings and Retail Price Settings in Energy-Only Markets: Navigating the Resource Adequacy Problem." *Energy Policy* 38 (11): 7427–7441. doi:10.1016/j.enpol.2010.08.023.

Sioshansi, F. P. 2008. "Competitive Electricity Markets: Questions Remain about Design, Implementation, Performance." *The Electricity Journal* 21 (2): 74–87. doi:10.1016/j.tej.2008.02.001.

Smith, A., and R. Raven. 2012. "What Is Protective Space? Reconsidering Niches in Transitions to Sustainability." *Research Policy* 41 (6): 1025–1036. doi:10.1016/j.respol.2011.12.012.

Streeck, W. 2011. "Taking Capitalism Seriously: Towards an Institutionalist Approach to Contemporary Political Economy." *Socio-Economic Review* 9 (1): 137–167. doi:10.1093/ser/mwq028.

Streeck, W., and K. Thelen. 2005. "Introduction: Institutional Change in Advance Political Economies." In *Beyond Continuity: Institutional Change in Advanced Political Economies*, edited by W. Streeck and K. Thelen, 30–39. Oxford: Oxford University Press.

Traber, T., and C. Kemfert. 2009. "Impacts of the German Support for Renewable Energy on Electricity Prices, Emissions, and Firms." *The Energy Journal* 30 (3): 155–155. doi:10.5547/ISSN0195-6574-EJ.

Watt, M., R. Passey, and W. Johnston. 2012. PV in Australia 2011. Australian PV Association. Accessed 13 November 2013. http://www.apva.org.au/sites/default/files/documents/APVA%20Status%20Reports/PV%20in%20Australia%202011.pdf

Wright, C., and D. Nyberg. 2015. *Climate Change, Capitalism, and Corporations: Processes of Creative Self-Destruction*. Cambridge: Cambridge University Press.